NAVAL HEALTH RESEARCH CENTER

EVALUATION OF TELEMEDICINE SATISFACTION AMONG NAVY RADIOLOGISTS

B. Bohannan

C. Strychacz

T. Melcer

Technical Document No. 03-1A

NAVAL HEALTH RESEARCH CENTER
P. O. BOX 85122
SAN DIEGO, CA 92186-5122

BUREAU OF MEDICINE AND SURGERY (M2)
2300 E ST. NW
WASHINGTON, DC 20372-5300

Evaluation of Telemedicine Satisfaction Among Navy Radiologists

Britt Bohannan[1]
Chris Strychacz[1]
Ted Melcer[2]
Test & Evaluation Group[2]

MTS Technologies, Inc.[1]
Naval Health Research Center[2]
Field Medical Technologies
P.O. Box 85122
San Diego, CA 92186-5122

Technical Document No. 03-1A was supported by the Office of Naval Research, Arlington, VA, under Work Unit No. 63706N.M2332.001-60004. The views expressed in this article are those of the authors, and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, or the U.S. Government. Approved for public release — distribution unlimited. Human subjects participated in this study after giving their free and informed consent. This research has been conducted in compliance with all applicable Federal Regulations governing the protection of human subjects in research.

Contents

Figures

Tables

Summary

Background

This study aimed to determine provider satisfaction with teleradiology in a military hospital. This study used a survey to assess radiology specific technologies not addressed in previous research, such as wireless radiography and computed radiographs (CR). This research also describes the perception and use of telemedicine by providers in two different medical specialties — otolaryngology and radiology — to determine the feasibility of using the same survey instrument to measure satisfaction in different telemedicine specialties (Whitten & Mair, 2000). Similar survey data from an earlier evaluation of ear, nose, and throat (ENT) specialist physicians and nonphysician medical personnel at the Naval Medical Center, San Diego (NMCSD) were included in the present paper for this purpose.

Method

A 60-item survey assessing satisfaction with telemedicine technologies was administered to 20 radiologists at NMCSD. The surveys were distributed during a staff meeting where respondents completed them in 15 minutes and did not interact with the researcher. Data from a previous study of mostly ENT providers and their cases are included in the present study. The ENT data were collected by a comparable survey administered to 3 ENT medical specialists, 5 physicians, and 7 nonphysicians via telephone interviews between November 1, 2000 and March 1, 2001. Questions assessing the general perceptions of telemedicine were identical for both studies. The differences between the two surveys are primarily in the details of technologies listed in particular to each specialty. Items measuring satisfaction, perception, and usefulness were presented on a 5-point Likert scale. The history of use and demographic data were presented in closed-ended categorical scales or numerical scales. A final open-ended question was included to capture other possible answers not included in the scales.

Results

Radiology personnel reported generally positive attitudes toward telemedicine technologies and the telemedicine process at NMCSD. Results were similar to those obtained during the previous study from ENT medical personnel, who also reported generally positive attitudes on telemedicine technologies and the telemedicine process.

Ninety percent (90%) of the radiologists reported having used CR in their jobs and they rated it high in usefulness (4.1 on a 5-point scale). Residents reported 1.7 years of use and range of 1 to 3 years, while radiologists reported 4.2 years of use and range of 1 to 10 years. These radiologists rated wireless technology a 3.8 in usefulness, also on the positive end of the scale. Of the 55% of radiologists reported to have used wireless radiography, residents reported an average 1.7 years of use and a range from 1 to 2 years. Radiologists reported an average of 4.7 years of use with a range from 2 to 10 years.

Conclusions

Respondents in both radiology and ENT specialties were generally satisfied with the telemedicine technology and reported similar positive attitudes about telemedicine and its role in health care in general. The ENT medical personnel responded positively to telemedicine technologies used in their practice (e.g., Referral Management System [RMS] and video teleconferencing [VTC]), and the radiology personnel responded positively to specific radiological technologies (e.g., wireless and CR).

These results suggest that the present survey instrument may be useful in providing data for systematic comparisons of these two telemedicine specialties and possibly other widely used specialties such as dermatology.

Introduction

Teleradiology involves the transmission of medical images, such as x-rays or magnetic resonance imaging, to a distant radiologist for interpretation (Linkous, 2002). Teleradiology enables a provider to have more immediate access to a radiologist/radiology specialist for consultation. Radiology is the most mature and rapidly evolving specialty in telemedicine (Abdullah, Ng, & Pathmanathan, 1999; Hailey, Roine, & Ohinimaa, 2002). Although diagnostic accuracy does not necessarily improve with teleradiology, accuracy does not diminish as compared with conventional, film-based radiology (Franken, 1998). Telehealth improves performance standards in the delivery of health care by creating information-rich learning environments and bringing best practices from around the world to carriers and practitioners wherever they are located (Australian and New Zealand Telehealth Committee, 1996). Therefore, this technology allows clinics without radiologists to access one and makes travel for patients and radiologists unnecessary.

High physician and patient satisfaction with telemedicine has been documented in several medical specialties, including dermatology (Lowitt, Kessler, Kauffman, Hooper, Siegel, & Burnett, 1998), telepsychiatry (Hilty, Luo, Morache, Marcelo, & Nesbitt, 2002; Simpson, Doze, Urness, Hailey, & Jacobs, 2001), vascular surgery (Endean, Mallon, Minion, Kwolek, & Schwarcz, 2001), pediatric cardiology (Mehta, Wakefield, Kienzle, & Scholz, 2001), and tele-ultrasound (Smith & Brebner, 2002). Lowitt and colleagues (1998) also found that the telemedicine consultation process improved the patient-physician bond, the attending physician's level of confidence, and in-person care.

Studies on CR showed radiologist satisfaction to be high after an initial warm-up period. Willis and Parker (1999) found that it takes about 3 months for experienced radiologists to reset their standards of "normal" to accommodate the change in contrast for the new CR images. (which generally have more contrast than conventional images.) However, most of the studies in teleradiology center on the resolution requirements for digital teleradiology and comparisons of diagnostic performance with traditional radiology. Therefore, questions remain regarding actual service performance using teleradiology, particularly in a military setting where CR images are increasingly used by remote treatment sites such as shipboard medical departments.

The U.S. military has been an effective supporter of digital imaging and teleradiology for the past 19 years. Beginning as a timesaving tool for the Naval Academy, this technology grew into a fully functional radiology support network for deployed ships, used primarily as tools to transmit x-ray images from ship to shore. Images are transmitted from ships to large medical facilities such as NMCSD, the National Naval Medical Center in Bethesda, MD, and hospitals in Portsmouth, VA, where staff radiologists can examine them and send back diagnoses. The digital imaging and teleradiology technology falls into two categories: machines that convert x-ray images into digital ones, and software used to transmit those digital images. CR, the method of converting x-ray images to digital ones, is being used increasingly on large ships and has numerous advantages over film-based methods (Karpf, 2001). Radiographic images are exposed onto phosphor plates and then converted directly to digital images, eliminating the need to develop film. This also eliminates problems resulting from the shipboard handling and disposing of chemicals used in the developing process. Brumage, Chinn, and Cho (2001) found teleradiology provided military hospitals significant cost savings over a 1-year period. However, there have been no studies thus far on provider satisfaction with teleradiology in a military setting. This research responds to a general directive to determine the factors that influence telemedicine impact and use, and provides teleradiology satisfaction data.

Telemedicine attitudes (e.g., perception of usefulness) and experience are positively associated with telemedicine use (Karp et al., 2000). A decline in physician satisfaction could

lead to lower retention rates for military physicians, as well as lower levels of physician performance, patient satisfaction, and quality of care (Rattelman, 1996). Teleradiology serves ship populations (Stoloff, Garcia, Thomason, & Shia, 1998), smaller facilities, and the Navy in general, by helping to divide the workload more evenly among all Navy radiologists. Telemedicine helps radiologists at remote stations by reducing their continually intense workload (Mun et al., 1998). Using telemedicine to balance the workload helps with retention by ensuring that no one is overworked, and it addresses the issue of physician shortages by allowing Navy medicine to make full use of available resources (Karpf, 2001).

For this study, access was provided to the NMCSD radiology department that uses teleradiology for ship-to-shore electronic transmissions of CR images in support of nonradiological shipboard providers. Teleradiology use affects patient care, including diagnosis and treatment, in similar nonmilitary contexts where radiologists reviewed the initial readings of radiographs by nonradiologists (e.g., Kiuru, Paqakkala, Kallio, Aalto, & Rajamaki, 2002). The present study included careful assessment of provider satisfaction with radiology-specific technologies not addressed in previous studies, such as wireless radiography and CR. Based on the literature (Karp et al., 2000; Hunter et al., 1999; Lee et al., 1998; Lowitt et al., 1998), a high satisfaction rate among military radiologists was expected.

The present study also included data from a prospective study of the ENT specialty that assessed attitudes and experiences with TRICARE Region 9 telemedicine (Melcer, Hunsaker, Crann, Caola & Deniston, 2002). In the future, such comparisons could assist in assessing the general provider satisfaction across different telemedicine specialties.

Method

The methodology for this study was a self-administered survey. This study was a single-point assessment of use, attitudes, and satisfaction with telemedicine by radiologists at NMCSD.

Data Sources and Subjects

Observations came from a survey administered at the beginning of an all-staff meeting for radiology personnel at NMCSD. Participation was voluntary and all personal identifying information (e.g., name, social security number) was excluded from the data collection.

Medical Personnel

A convenience sample of radiology personnel from NMCSD completed the surveys. These were general radiologists (*N* = 9) and resident radiologists (*N* = 11), 18 males and 2 females. All but one of these twenty individuals were active duty; one resident radiologist was in military reserve. Ten percent (*N* = 2) of this sample had been ship deployed within the last year. The present sample of twenty was less than half (43%) of the 46 radiologists at NMCSD. The 46 radiologists and residents at NMCSD include 17 active-duty radiologists, 1 full-time civilian radiologist, 26 residents, and 2 active-duty nuclear medicine specialists. Currently, approximately 92 radiologists serve in the Navy.

Naval Medical Center, San Diego

NMCSD is part of TRICARE Region 9, which provides primary health care for active-duty and retired service personnel, their eligible family members, and their survivors. The radiology department chiefly uses digitally stored radiographs instead of film. The department is currently studying CRs taken shipboard to determine the feasibility of using CRs to facilitate storage and transmission of shipboard and land-based consultations.

Data Analysis

The data analysis was designed to address the following questions:

- What is the experience of radiology and ENT personnel regarding telemedicine?
- Do radiology and ENT personnel perceive telemedicine to be useful?

Preliminary trends are described for the data because of the small samples of 9 general radiologists and 11 resident radiological personnel. The ENT data from Melcer et al. (2002) contained similar sample sizes. Thus, any comparisons between ENT physicians and radiologists should be interpreted with caution.

Results

Medical personnel in the radiology department reported generally positive attitudes on telemedicine technologies, types of use, quality of technologies, and the telemedicine process at NMCSD. Compared with resident radiologists, general radiologists had used telemedicine longer, though there were no apparent differences between these two groups in types of telemedicine use or frequency.

Compared with ENT participants from the previous study, radiologists in the present study used telemedicine more for patient education (28% of radiologists vs. 11.5% of ENT personnel), provider education (28% of radiologists vs. 5% of ENT personnel), and technical support (43% of radiologists vs. 5% of ENT personnel). Only in confirming diagnoses did ENT personnel score higher than radiologists, with 78% using telemedicine to confirm diagnoses, versus 55% of radiologists.

Demographics

The radiology and ENT samples consisted predominantly of active-duty males. However, the samples did include females, representing approximately 20% of the total sample, and civilians, representing around 11% of the total sample. Fewer than 5% of the total sample had been ship deployed within a year prior. The radiologist population included 11 resident radiologists and 9 practicing radiologists (see Table 1). The group in the previous study is given the ENT designation based on the fact that such consultations, which were the most common for this region, rely on real-time VTC (Melcer et al., 2002). Teleradiology, on the other hand, does not usually rely on real-time consultations but uses a store-and-forward mode in most cases.

Table 1. Radiologist and ENT Demographics

	Radiologist Demographics		ENT Demographics	
Total	***N***	**%**	***N***	**%**
	20	100	15	100
Gender				
Male	17	85	11	73
Female	3	15	4	26
Military status				
Active duty	19	95	12	80
Civilian	1	5	3	20
Ship deployed in the last year				
Yes	1	5	NA	
No	19	95	NA	
Located at other facility in the last year				
Yes	5	25	NA	
No	15	75	NA	
Title				
Radiologist	8	40	NA	NA
Specialist	1 (nuc. med)	5	3 (neurology, child psych, ENT)	20
Resident	11	55	NA	NA
Physician		NA	5	33
Non-physician	NA	NA	7 (1 IDC, 4 med techs, 1 nurse, 1 PA)	46

Note: IDC = independent duty corpsman; PA = physician's assistant

Technology Experience

The radiologists in this study and the ENT personnel in the previous study had used the telephone to confirm a diagnosis and had access to and used e-mail and the Composite Health Care System (CHCS). All radiologists and 86% of ENT personnel reported using the Internet before, while 88% of radiologists and only 55% of ENT personnel had previously used VTC. Eighty-six percent of ENTs had used an RMS.

Ninety percent of the radiologists had used CR in their jobs, and they rated it high in usefulness (4.1 on a 5-point scale). Residents reported 1.7 years of use and range of 1 to 3 years. Radiologist reported 4.2 years of use and range of 1 to 10 years. Of the 55% of

radiologists who reported past use of wireless radiography, residents had used this technology for 1.7 years and radiologists for 4.7 years.

Past Telemedicine Use

Table 2 shows the medical reasons for which the radiology and ENT personnel reported using telemedicine technologies. Confirming diagnosis was the primary reason reported for past telemedicine. All of the 18 radiology personnel who responded to this section had at some point used at least one of the telemedicine technologies to confirm a diagnosis; 100% had used the telephone to confirm a diagnosis. The ENT personnel, however, were more likely to use all the telemedicine technologies for diagnosis confirmation.

The ENT personnel were also consistently more likely than all the radiology staff to use telemedicine for patient education. The radiologists were less likely than ENT personnel to use telemedicine for continuing medical education (not shown in Table 2). An average of 28% of the radiologists and 57% of the ENT personnel used telemedicine for continuing medical education.

Table 2. Past Use of Telemedicine Technologies by Medical Personnel

	Radiologists *N* = 20		**ENT Personnel *N* = 15**	
Telemedicine Technology	**Diagnosis Confirmation %**	**Patient Education %**	**Diagnosis Confirmation %**	**Patient Education %**
Telephone	100	44	100	58
Fax	70	21	88	26
E-mail	79	43	100	67
Internet	41	62	100	80
CR	75	NA	NA	NA
Wireless	34	0	NA	NA
VTC	6	0	100	54
Overall average	55	28	96	57

Current Access to Telemedicine Technologies

Table 3 shows that all the resident and general radiologists at NMCSD had current access to various telemedicine technologies. This table is broken down between residents and general radiologists due to the substantial differences of years worked in radiology. All personnel reported well over 1 year of experience with each technology. General and resident radiologists reported similar technology experience but reported apparent differences in VTC, wireless, and RMS. This difference might be expected because the residents had fewer total years of medical experience. However, they still had a substantial amount of technology experience and a reasonable amount of telemedicine experience. On average, the radiologists reported more years of use in each technology than the ENT personnel in the previous study.

Table 3. Current Access to Telemedicine Technologies by Medical Personnel

	General Radiologists *N* = 9		Resident Radiologists *N* = 11		ENT Personnel *N* = 15	
Technology	**Current Access %**	**Years Used (*M*)**	**Current Access %**	**Years Used (*M*)**	**Current Access %**	**Years Used (*M*)**
E-mail	100	10.13	100	7.5	86	4.5
RMS	NA	NA	NA	NA	86	1.6
CHCS	100	8.63	100	8.25	NA	NA
CR	88	4.2	100	1.7	NA	NA
Wireless	63	4.7	100	1.7	NA	NA
Internet	78	8	75	4.2	86	3.4
VTC	75	3.17	25	5	86	1.7

Note: CHCS = Composite Health Care System

Purposes of Telemedicine Use

Table 4 shows the reasons for recent telemedicine use by radiologists (over the last 4 months) and by ENT personnel during a similar period in the previous study. Differences between the radiologists and ENT personnel were visible in the overall distribution of telemedicine purposes. The radiologists were considerably more likely than the ENT personnel to use telemedicine for technical support. In contrast, the ENT personnel were more likely to use telemedicine to confirm diagnoses. These results should be interpreted with caution due to the general radiologists high percentage of unanswered usage questions (25.7%).

Table 4. Recent Telemedicine Usage by Medical Purpose

	Confirm Diagnosis %	Patient Education %	Continue Medical Education %	Technical Support %	Unknown %
Radiologist (*N* = 9)	28	9	7.1	30.2	25.7
Resident Radiologist (*N* = 11)	54	6	20	20	0
ENT Physician (*N* = 8)	68	3	9	9	11
ENT Non-physician (*N* = 7)	77	16	1	1	5

Level of Telemedicine Activity

Table 5 summarizes radiological personnel reports of overall patient load and telemedicine activity during the single-point study period. The telemedicine ratio for radiologists is very low in this table, and the actual ratio may be higher. The radiologists may not have perceived the computed images they worked on as telemedicine patients. For future studies, it may be worth clarifying this question so that respondents treat CR images as telemedicine cases.

Table 5 also reveals that ENT personnel in the previous study reported substantially more telemedicine activity than radiologists in the present study. This is seen in the number of telemedicine cases and in the ratio of telemedicine cases to all patient care during the study period (telemedicine cases/telemedicine and nontelemedicine cases). Note that these are discrete means based on all respondents, and the ratio is not a ratio of means.

Table 5. Telemedicine Activity Reported by Medical Personnel

Telemedicine Activity (last 4 months)	**Radiologists *N* = 20 (*M*)**	**ENT *N* = 15 (*M*)**
Telemedicine patients seen (TMED)	37	124
Total patients seen (TMED + non-TMED)	1936	1159
Telemedicine ratio (TMED/TMED + non-TMED)	5%	37%

Satisfaction With Telemedicine

Figure 1 shows mean scores (+/- ½ standard deviation) for medical personnel attitudes toward satisfaction with technologies (e.g., e-mail, VTC), satisfaction with different modalities (images, sound, written text) transmitted by telecommunications, usefulness of technologies, and overall perception of telemedicine for health care.

Figure 1 indicates that ENT personnel in the previous study reported consistently favorable attitudes toward telemedicine across all types of questions. Radiologists in the present study were slightly lower, though still in the “satisfied” area of the scale. They rated their attitudes on a 5-point scale, with more positive attitudes indicated by higher scores (e.g., 5 = very satisfied, 4 = somewhat satisfied, 3 = undecided, 2 = somewhat dissatisfied, 1 = very dissatisfied). Similar scores were reported for radiologists and ENT personnel averages

within each of the four attitude variables. Each of the four attitude variables consisted of six to ten different questions.

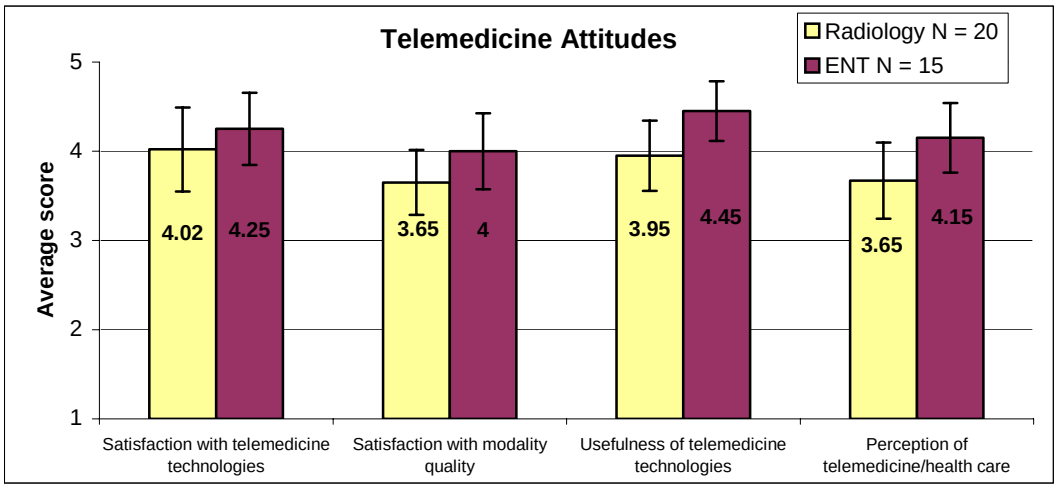

Figure 1. Telemedicine Attitude Scores Reported by Medical Personnel

Usefulness received the highest ratings of the four attitude variables for radiologists, with CR scoring the highest and Internet second. Responding to questions about their satisfaction with specific modes of transmitted information, the radiologists rated phone and e-mail the highest. Since RMS and store-and-forward were not applicable to many radiologists, many did not answer or replied with an "undecided" score of 3. ENT personnel gave high ratings on the usefulness of VTC (*M* = 4.45). In order to ensure there was no response set in the survey (i.e., agreement with all statements), three questions were worded negatively so that respondents would have to disagree to indicate a favorable attitude toward telemedicine:

- The quality of patient care rendered through the use of telemedicine is inferior to that provided in person.
- Existing telemedicine systems do not meet my practical needs as a healthcare provider.
- Most existing telemedicine systems are too limited to be effective.

The average rating for these three questions was 2.8, which was on the negative end of the scale.

The attitude portion of the survey consisted of different sections designed to measure three separate constructs: satisfaction, usefulness, and perception of telemedicine and health care. Internal consistency of this survey is important to determine if the instrument will perform the same when administered at different times to the same sample. Therefore, the questions intended to measure each construct were evaluated for reliability using Cronbach's alpha. Questions 27-36 on the survey regarding satisfaction in general were combined with questions 37-42 covering satisfaction of particular technologies to calculate the reliability. The following standardized item alphas resulted: satisfaction, $\alpha = .75$; usefulness, $\alpha = .93$; perception of telemedicine and health care, $\alpha = .74$. Reliability scores are considered acceptable at .70 (Nunnally, 1978), therefore these scores are considered high, especially for usefulness.

The same attitude portion of the survey for the previous ENT survey was also high, with reliability scores of satisfaction, $\alpha = .87$, and perception of telemedicine and health care, $\alpha = .94$. Usefulness scored at $\alpha = .64$. This score is considered low and could be due to the data

for “usefulness” being multidimensional, rather than because of poor reliability. When data have a multidimensional structure, Cronbach’s alpha will usually be low. A check of multidimensionality revealed there were at least two, possibly three subsets, though a reliability analysis of these subsets was not possible due to the small sample sizes in the present research.

Figure 2 below indicates that the general and resident radiologists in the present study reported favorable attitudes on teleradiology technologies. The average scores (+/- ½ standard deviation) were calculated for satisfaction in each area. The two groups showed similar mean scores on satisfaction with modality quality, usefulness of technologies, and perception of teleradiology-specific technologies.

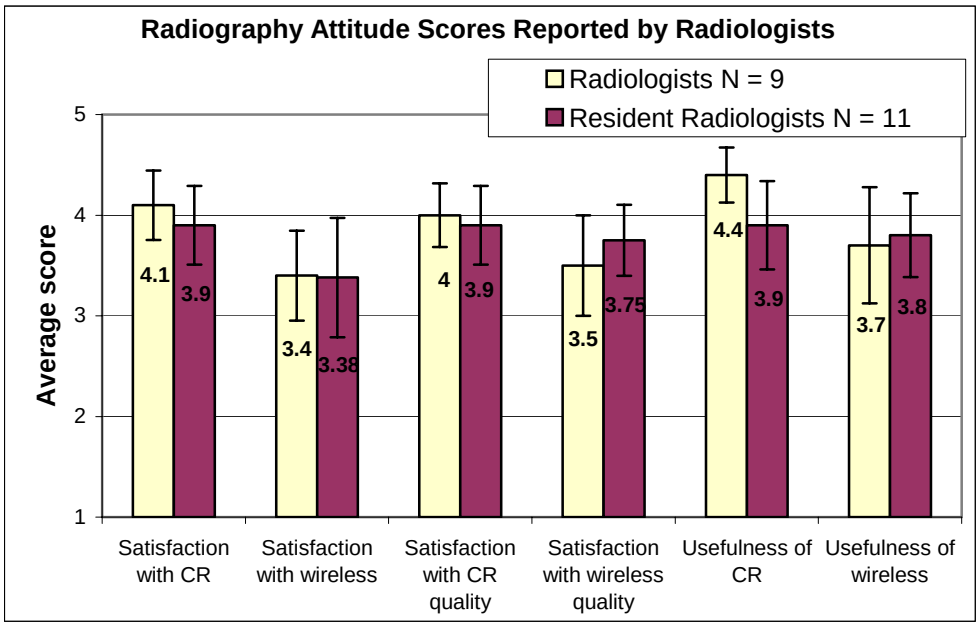

Figure 2. Radiography Attitude Scores Reported by Radiologists

Comments by Medical Personnel

At the end of the structured question section of the surveys in the previous and present studies, the medical personnel were asked if they had additional comments. The radiology personnel offered no comments. ENT personnel supplied favorable comments about the RMS and VTC, but reported unacceptably low quality for child psychiatry (Melcer et al., 2002). Other comments indicated that other types of telemedicine, including video, would be useful. The ENT data were gathered via telephone, which may have elicited more comments than the self-administered radiology survey.

Discussion

The present results support several conclusions:

- The radiology and ENT personnel at NMCSD had substantial telemedicine experience, and both groups of providers reported positive attitudes toward the telecommunications technologies they used, and the role of telemedicine in health care processes in general.

- Most previous military radiology studies focus on patient satisfaction or physician agreement between teleradiology and film. The present study demonstrates favorable attitudes on teleradiology in the present sample of radiologists. The present survey revealed a trend for relatively low satisfaction with wireless versus CR, and therefore the survey may be useful for evaluating satisfaction with alternative radiology technologies in large-scale studies.

- Radiologists rated teleradiology-specific technologies, such as CR images and wireless, high in satisfaction. However, a trend seemed to emerge suggesting greater satisfaction for CR than for wireless and CR. One of the factors that could be contributing to this pattern of preference is the advantage in image modification of CR over wireless. Pathi and Langlois (2002) found that digital radiography offered significant image modification advantages over wireless, meaning that the digital images could be manipulated to aid viewing. Another factor that could be contributing to the pattern of preference is the existence of problems in the speed and connectivity of wireless transmission (Yamamoto & Williams, 2000).

- The success in using the satisfaction survey instrument across two telemedicine disciplines, ENT and radiology, indicates that the instrument may be useful in systematic comparison of multiple telemedicine specialties.

Attitudes and Telemedicine Experience

Radiologists in this study reported that teleradiology is useful with positive experiences. A trend worth investigating was the possible relationship between the experience and attitudes of the radiology personnel: general radiologists reported more years of experience with technology than the residents and also slightly higher overall attitude scores for CR (see Table 3 and Figure 2). Telemedicine attitudes do correlate positively with telemedicine experience in at least one study (Karp et al., 2000), and the radiologists in general gave accounts of possessing significant computer and technological experience. However, significant correlations were not found between telemedicine experience and satisfaction in the radiologist's responses. Also, ENT personnel in the previous study rated telemedicine slightly higher on the whole than radiologists, although they had fewer years of overall experience with telemedicine than radiologists. Multivariate analyses of variance were performed to assess differences in attitude scores between radiologists and ENTs in Figure 1 and between radiologists and residents in Figure 2. The analyses suggest no significant differences in attitudes across groups (multivariate p's > .10.)

Recommendations and Future Work

Several recommendations have developed as a result of this study:

- In the future, further quantitative studies may be useful to test trends noted in the present study on satisfaction with and use of teleradiology. As in the ENT study, telephone interviews or focus groups would most likely obtain more comments than in self-administered surveys.

- Data on actual patient outcomes and telemedicine use over time could be correlated with provider satisfaction data to obtain a more complete picture of telemedicine use. Although the present study included 21% of Navy radiologists, acquiring a larger, stratified sample — including multiple sites where teleradiology is being used — would provide results that would not be specific to one location. Conversely, studies centering on the use of teleradiology in a specific type of setting could reveal details that will assist in developing teleradiology for that specific setting. For example, what is the impact of teleradiology, if any, on emergency care?

- Assessing the teleradiology satisfaction of remote treatment site providers and shipboard providers would provide a different perspective on teleradiology using the same satisfaction tool.

- Studies of teleradiology on a larger scale could be beneficial for large-scale planning. For example, such studies could aid the application of telemedicine to casualty receiving ships, where the majority of the casualties would be seen in a wartime setting, or in a humanitarian setting for peacetime missions.

References

Abdullah, B. J., Ng, K. H., & Pathmanathan, R. (1999). The impact of teleradiology in clinical practice: A Malaysian perspective. *Medical Journal of Malaysia, 54*(2), 169-174.

Australian and New Zealand Telehealth Committee. (1996). *Australian Telehealth Services Issues Paper*. Retrieved November 15, 2002 from http://www.telehealth.org.au.

Brumage, M. R., Chinn, S., & Cho, K. (2001). Teleradiology in a military training area. *Journal of Telemedicine and Telecare, 7*(6), 348-352.

Endean, E. D., Mallon, L. I., Minion, D. J., Kwolek, C. J., & Schwarcz, T. H. (2001). Telemedicine in vascular surgery: does it work? *Am Surg*, *67*(4), 334-341.

Franken, E. A. (1998). *Teleradiology Project*. Retrieved September 28, 2002 from http://telemed.medicine.uiowa.edu/index.html.

Hailey, D., Roine, R., & Ohinimaa, A. (2002). Systematic review of evidence for the benefits of telemedicine. *Journal of Telemedicine and Telecare, 8*(Suppl. 1), 1-7.

Hilty, D. M., Luo, J. S., Morache, C., Marcelo, D. A., & Nesbitt, T. S. (2002). Telepsychiatry: an overview for psychiatrists. *CNS Drugs, 16*(8), 527-548.

Hunter, D. C., Brustrom, J. E., Goldsmith, B. J., Davis, L. J., Carlos, M., Ashley, E., Gardner, G., Gaal, I. (1999). Teleoncology in the Department of Defense: A tale of two systems. *Journal of Telemedicine, 5*(3), 273-282.

Kangarloo, H., Valdez, J. A., Yao, L., Chen, S., Curran, J., & Goldman, D. (2000). Improving the quality of care through routine teleradiology consultation. *Academy of Radiology, 7*(3), 149-155.

Karp, W. B., Grigsby, R. K., McSwiggan-Hardin, M., Pursley-Crotteau, S., Adams, L. N., & Bell, W. (2000). Use of telemedicine for children with special healthcare needs. *Pediatrics*, *105*, 843-847.

Karpf, B. (2000). Navy telemedicine sails “off-the-shelf”: An interview with CAPT Richard S. Bakalar. *U.S. Medicine*, *6*(2), 2, 28.

Kiuru, M. J., Paakkala, T. A., Kallio, T. T., Aalto, J., & Rajamaki, M. (2002). Effect of teleradiology on the diagnosis, treatment and prognosis of patients in a primary care centre. *Journal of Telemedicine and Telecare, 8,* 25-31.

Lee, J. K., Renner, J. B., Saunders, B. F., Stamford, P. P., Bickford, T. R., Johnston, R. E., Hsaio, H. S., & Phillips, M. L. (1998). Effect of real-time teleradiology on the practice of the emergency department physician in a rural setting: Initial experience. *Journal of Telemedicine and Telecare*, *4*(Suppl. 1), 11-14.

Levine, B. A., Cleary, K., & Mun, S. K. (1998). Deployable teleradiology: Bosnia and beyond. *IEEE Transactions on Information Technology inl Biomedicine,* March*, 2*(1), 30-34.

Linkous, J. D. (2002). Telemedicine: An overview. *The Journal of Medical and Practical Management, 18*(1), 24-27.

Lowitt, M. H., Kessler, I. I., Kauffman, C. L., Hooper, F. J., Siegel, E., & Burnett, J. W. (1998). Teledermatology and in-person examinations: A comparison of patient and physician perceptions and diagnostic agreement. *Archives of Dermatology*, *134*(4), 471-476.

Melcer, T., Hunsaker, D. H., Crann, B., Caola, L., & Deniston, W. (2002). A prospective evaluation of ENT telemedicine in remote military populations seeking specialty care. *Telemedicine and e-Health, 8*(3), 301-311.

Mehta, A. R., Wakefield, D. S., Kienzle, M. G., & Scholz, T. D. (2001). Pediatric tele-echocardiography: Evaluation of transmission modalities. *Telemed Journal and e-Health, 7*(1), 17-25.

Mun, S. K., Levine, B., Cleary, K., & Dai, H.. (1998). Deployable teleradiology and telemedicine for the US military. *Compututer Programs and Methods in Biomedicine, 57*(1-2), 21-27.

Nunnally, J. (1978). *Psychometric Theory*, Second Edition. New York: McGraw-Hill.

Pathi, R., & Langlois, S. (2002). Evaluation of the effectiveness of digital radiography in emergency situations. *Australian Radiology, 46*(2), 167-169.

Rattelman, C. R. (1996). Tricare Tidewater: An Analysis of Military Physician Satisfaction, 82pp, CNA, Research Memorandum 95-199, March (DTIC Report ADA310679). Alexandria,VA: Center for Naval Analyses.

Simpson, J., Doze, S., Urness, D., Hailey, D., & Jacobs, P. (2001). Evaluation of a routine telepsychiatry service. *Journal of Telemedicine and Telecare*, *7*(2), 90-98.

Smith, P., & Brebner, E. (2002). Tele-ultrasound for remote areas. *Journal of Telemedicine and Telecare, 8*(Suppl. 2), 80-81.

Stoloff, P. H., Garcia, F. E., Thomason, J. E., & Shia, D. S. (1998). A cost-effectiveness analysis of shipboard telemedicine. *Telemedicine Journal*, *4*(4), 97-99.

Whitten, P. S., & Mair, F. (2000). Telemedicine and patient satisfaction: Current status and future directions. *Telemedicine Journal and e-Health*, *6,* 417-424.

Willis, C. E., & Parker, B. R. (1999). In pediatrics, CR may become the ideal detector. *Diagnostic Imaging, 21*(11), 175-183.

Yamamoto, L. G., & Williams, D. R. (2000). A demonstration of instant pocket wireless CT teleradiology to facilitate stat neurosurgical consultation and future telemedicine implications. *American Journal of Emergency Medicine, 18*(4), 423-426.

REPORT DOCUMENTATION PAGE

1. Report Date (DD MM YY)	2. Report Type	3. DATES COVERED (from - to)
16 Jan 03	Final	Jul1, 02 to Nov 30, 02

4. TITLE AND SUBTITLE
Evaluation of Telemedicine Satisfaction Among Naval Radiologists

. AUTHORS
Britt Bohannan, Ted Melcer, Chris Strychacz

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Naval Health Research Center
P.O. Box 85122
San Diego, CA 92186-5122

8. SPONSORING/MONITORING AGENCY NAMES(S) AND ADDRESS(ES)
Chief, Bureau of Medicine and Surgery
M2
2300 E St NW
Washington DC 20372-5300

5a. Contract Number:
5b. Grant Number:
5c. Program Element: 63706N
5d. Project Number: M2332
5e. Task Number: 001
5f. Work Unit Number: 60004

9 PERFORMING ORGANIZATION REPORT NUMBER
Tech Doc No. 03-1A

10. Sponsor/Monitor's Acronyms(s)
BuMed

11. Sponsor/Monitor's Report Number(s)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT (maximum 200 words)

The focus of this study was to assess levels of satisfaction and experience among radiologists using teleradiology and other telemedicine technologies at the Naval Medical Center, San Diego (NMCSD). This study was conducted using a survey administered to resident radiologists, radiologists, and radiology specialists. The survey information was used to compare and contrast the attitudes of users and measure their recent use of telemedicine. This study included assessment and comparison of radiology-specific technologies not addressed in previous studies, such as wireless radiography and computed radiography (CR). A secondary focus of this study was to assess the generalizability of the satisfaction survey instrument used across other telemedicine disciplines.

A 60-item survey assessing satisfaction with telemedicine technologies was administered to 20 radiologists at NMCSD. Data from a previous ear/nose/throat (ENT) specialist is included as a comparison with data collected in the present study. Questions assessing general perceptions of telemedicine were the same for both studies. The differences between the two surveys were primarily in details of technologies listed as being specific to each specialty. Items measuring satisfaction, perception, and usefulness, as well as history of use and demographic data were presented. A final open-ended question was included to capture other possible answers not included in the scales.

Respondents, ENT and radiology personnel alike, were generally satisfied with the telemedicine technology and process and had very similar positive attitudes about telemedicine in general. The ENT medical personnel responded positively to specific telemedicine technologies specific to their practice, (e.g., Referral Management System and video teleconferencing), and the radiology personnel responded positively to specific radiological technologies (e.g., wireless and CR).

The success in using the satisfaction survey instrument across these two telemedicine disciplines indicates that it may be generalizable across all medical specialties.

15. SUBJECT TERMS
None

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	b. THIS PAGE			Commanding Officer
UNCL	UNCL	UNCL	UU	22	19b. TELEPHONE NUMBER (INCLUDING AREA CODE) COMM/DSN: (619) 553-8429